EFFECTS ON SHORT AND MEDIUM TERM PREDICTIONS OF DISCARD DATA INCLUSION INTO ASSESSMENT. SOUTHERN MEGRIM ASSESSMENT AS AN EXAMPLE.

Jose Mª Bellido and Nélida Pérez
Centro Oceanográfico de Vigo
Instituto Español de Oceanografía (IEO)

Summary

TOR c of WGHMM 2004 encourages to *ñprovide specific information on possible deficiencies in the 2004 assessments including, at least, any major inadequacies in the dataò* This WD shows the discard data available to use in assessment from 1987 onwards. Data comprises hake, megrims and anglerfish both from northern and southern stocks assessed at WGHMM. The reliability of data is represented with a traffic light risk visual code. An example of how to integrate discard data into assessment is made with Southern Megrim (*Lepidorhombus whiffiagonis*) and comparisons of the assessment and predictions with and without discards are reported. Finally, conclusions state the necessity of an accurate sampling design as well as some advantages and disadvantages of using discard data in assessment. Obviously, it produces a more real picture of the fishing exploitation. However, on the other hand we might add another important source of uncertainty to the assessment model and increasing the parameterization of the model.

Keywords: discard data, assessment, simulation, *Lepidorhombus whiffiagonis*.

Introduction

TOR c from WGHMM 2004 ask for *ñprovide specific information on possible deficiencies in the 2004 assessments including, at least, any major inadequacies in the data on catches, effort or discards; any major inadequacies in research vessel surveys data, and any major difficulties in model formulation, including inadequacies in available software. The consequences of these deficiencies for assessment of the status of the stocks and for the projection should be clarifiedò*

The ICES Study Group on Discard and By-Catch Information (SGDBCI, 2000) pointed out that only relatively few information of discard is incorporated in working groups for stock assessments. One of the impediments is the lack of discard fisheries data by country which fulfils requirements related to stock assessment. Discard data are not essential to obtain the historic trends of Spawning Stock Biomass (SSB). Nevertheless, discard data are useful for tuning the assessment related to recruitment variability. Furthermore, estimation of discard weights of commercial vessels is essential when discarding may cause a reduction of the yield in medium and long-term projections and has effects on management measures and setting biological reference points which rely on recruitment variability (Lart *et al*., 2002).

Eluding discard estimation could prompt bias in the recruitment and fishing mortality (F) estimates of VPA (Virtual Population Analysis) in the assessment of mixed-fisheries where discards are high relevant. This occurs for the Spanish trawl fleets, characterised for being mixed fisheries with continuous changes in the target species, and based on a large range of species (including horse mackerel, blue whiting, mackerel, hake, two species of anglerfish and megrim, Norway lobster or different cephalopods).

Apart from the advantage of using discards in assessment, fisheries monitoring with observers on board increases the detail and accuracy of the basic information and also supports management decisions to improve the conservation of exploited stocks. The knowledge of discard and their use in stock assessment may also help, in co-operation with industry, to refine fishing and management strategies (Kulka, 1999).

This working document aims to compare the VPA results with and without discards for Southern stock of Megrim (Divisions VIIIc and IXa). The use of discard information was implemented to improve the stock assessment and to compare results of trends in catches, mean F, SSB and

recruitment and yield in short and medium term projection. They would illustrate the necessity to include discard data in stock assessment.

Material and Methods

There are at least four parameters needed for incorporation of discard data into stock assessment:

1. Total estimated discard weight by Fisheries Unit and year or by Country and year (D).
2. Discard length distribution by Fisheries Unit and year or by Country and year (L).
3. Discard age composition by country and year (ALK by country and year) (A).
4. Mean weight at age by country and year (W).

ICES Spanish discard information comes from observers on commercial boats of the Spanish trawl fleet operating in Sub-areas II and XII, in Great Sole, Rockall and Porcupine Banks i.e. ICES areas VI and VII (sampling vessels based on Galician ports) and the North Atlantic waters of the Iberian Peninsula (ICES Divisions VIIIc West and Central, and IXa North). Data collection is based on voluntary cooperation of vessels. Assumption that discarding behaviour do not change with observer on board is made.

Sampling took into account the different Fishery Units since 1997. Fishery Units were defined based both on a deductive knowledge of the fishery units and objective methods of multivariate analysis. Regarding the study area (ICES Divisions VIIIc West and Central, and IXa North), every Fishery Unit was defined according to area, gear and target species and they are as follow:

1. Spanish Baka Otter Trawl Mixed Fishery. (ICES VIIIc central)
2. Spanish Baka Otter Trawl Mixed Fishery (ICES VIIIc west and IXa)
3. Spanish Very High Vertical Opening Bottom Trawl targeting horse mackerel (ICES VIIIc west and IXa)
4. Spanish Pair Bottom Trawl targeting blue whiting (ICES VIIIc west and IXa)

Table I shows years where discard data are available. Colours represent a traffic light risk visual code to use these data into assessment because of the uncertainty as well as possible bias in the sampling. These could be due to:

- 1987 - 88: Sampling design with possible deficiencies. These years were like pilot surveys to improve the sampling design later.
- 1993: Small coverage sampling (few samples covering the whole year).
- 1999: Half year sampling (good number of samples covering the 2nd semester).
- 2001: Half year sampling (few samples and only covering the 2nd semester).

The Southern Megrim case

Southern Megrim (*Lepidorhombus whiffiagonis* in Divisions VIIIc-IXa), was chosen to explore different options of assessment, with and without discards. VPA assessment (standard at WGMHH), was tuned only with one fleet, a Spanish survey (where information on discard it is not necessary), avoiding estimations of discards for commercial tuning fleets.

Portuguese and Spanish information of landings (number and weight at age) landings and stock mean weights at age by ALK (mean values in years with no data), proportion mature and natural mortality, came from the values estimated by WGHMM 2003 (Anon, 2003). An important source of variation in the discard estimations would be the choosing of raising method. Raising by landings both in weight and number was applied because of there is no relation between discards and hours of trawling, i.e. effort (Trenkel *et al*. 2000, and Lema *et al.*, 2002). In addition, Pérez *et al.* (1999) found that the highest difference in the estimation of discards appeared when using raising by effort.

Abundance indices (ages 1 to 7) from only Spanish Demersal Survey were used for XSA in order to estimate the Recruitment, SSB and F. Although information available in ICES for the

assessment starts at 1986, only values from 1990 were used for the simulations. This was done in order to avoid the very likely change in exploitation pattern (especially in the short lengths more affected by discarding) due to the 1990 change in MLS from 25 cm to 20 cm (Regulation (CEE) n 4056/89). Selecting this year range also avoided the use of mean ALKs (ICES Working Group assessments for the years prior 1990).

An estimation of discard was made for the years where sampling was not available. Hence, A linear regression by age was applied using data from years 1994, 1997, 1999 and 2000.

$$N_{Di} = a + b\, S_{Ii}$$

where

N_{Di} = *Number of fish discarded at age i*
S_{Ii} = *Survey abundance index at age i*
intercept a set to zero

Then, discard estimation by age was produced for years 1990-1993, 1995, 1996, 1998, 2001 and 2002. Finally, a new catch-at-age matrix was built, comprising landings and discard numbers.

Two different XSA options were run, with and without discards. Short-term projections (non-scaled average F_{sq}) and medium term projections were made.

Results

XSA Results: The two analyses were plotted to show any systematic pattern (see Fig 1). The recruits, Spawning Stock in number (SS) SSB and F estimates obtained from XSA are shown in Figure 3. Patterns are similar for both options. Nevertheless, slight differences in the SSB estimates with discards were observed. The option with discards presents higher values at the beginning of the series than the option without discard and, on the contrary, lower values for recent years.

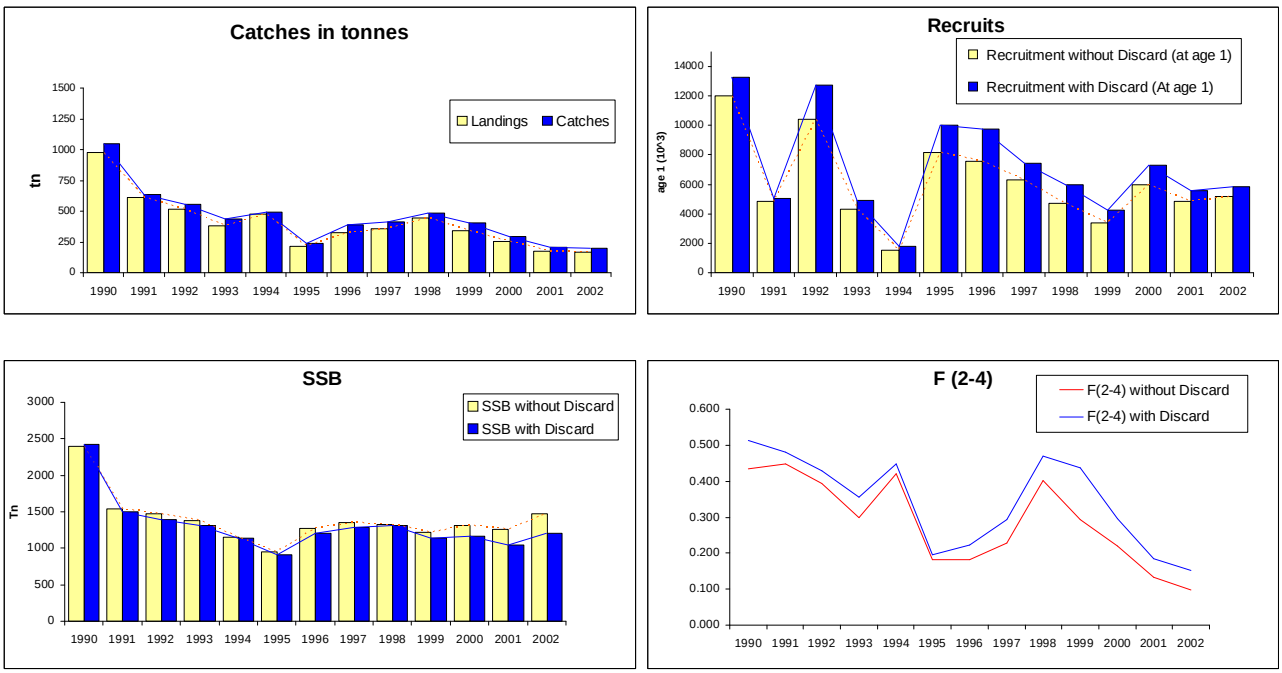
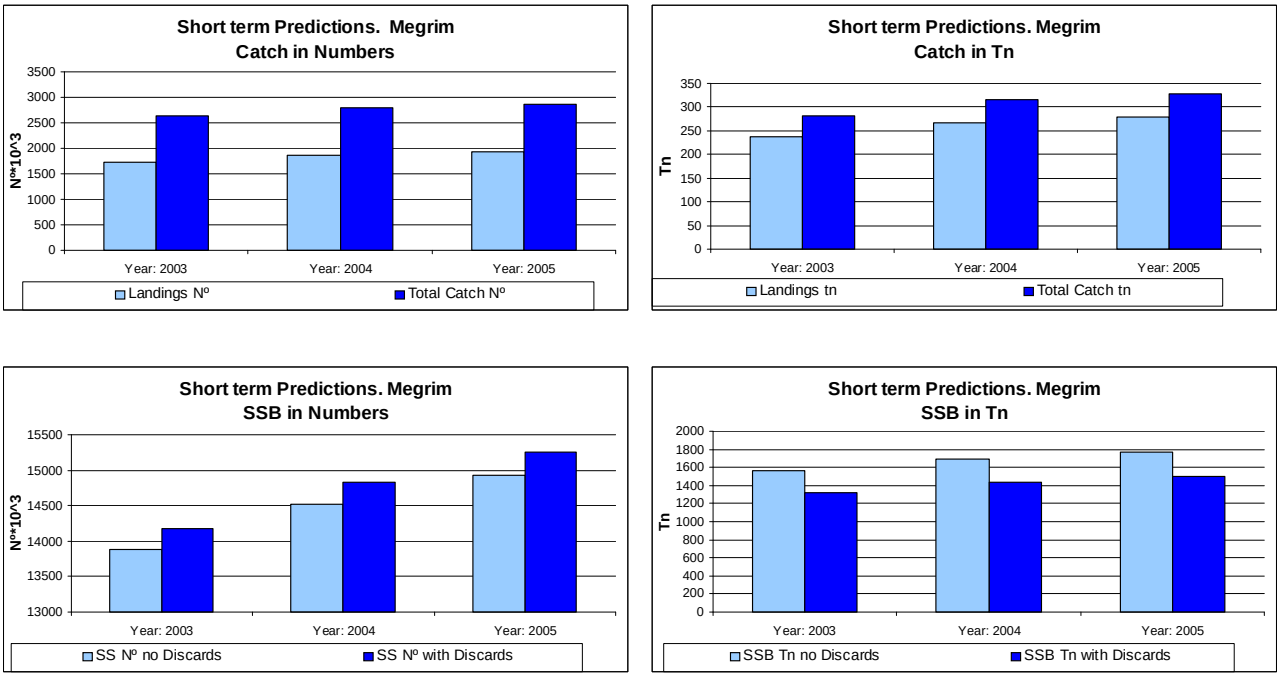


Figure 1. XSA Results: Landings (without discards) vs Catches (with discards)

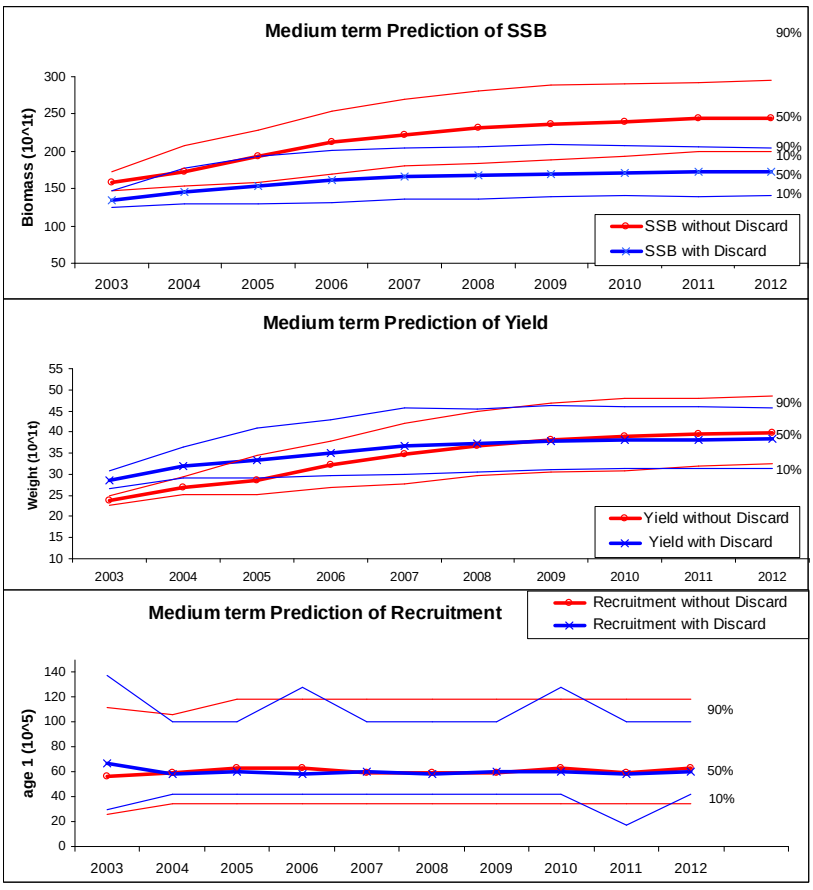
Short term predictions: Figure 4 presents the short-term yield and trends in landings and catches, SS in number and SSB from 2002 to 2004 assuming status quo F, for both options (without and with discards). Differences are clear, especially in SS numbers.

Figure 2. Short term predictions in number and weight for catch and SSB.



Medium term predictions: Probability profiles of expected SSB, yield and Recruitment are given in Figure 3. A random bootstrapped recruitment over the whole period was used for estimating recruitment for medium-term predictions. Results are summarised in Figure 6. Landings and SSB are predicted to increase gradually in both cases. The predicted increase in SSB is mostly due to the low status quo F (F_{2-4} in the period 99-01 have some of the lowest values of the series) and to the higher recruitment estimated in the random bootstrap. Nevertheless, the SSB projections including discard estimates are significantly lower than those made without discards.

Figure 3. Medium term prediction of SSB, yield and recruitment.



Conclusions

1. It is essential an accurate sampling design. Otherwise, bias could prompt bizarre results. Allen *et al.* (2002) mentioned a need of sampling for Baka trawlers of an average seven hauls per trip requires either one trip for 39 vessels or two trips for 25 vessels to obtained a CV of 20%.

2. Even with an accurate sampling design, it is difficult to carry out it completely. A discard programme generates a great scientific and technical effort to get any estimation.

3. Including discard data into assessment has got both advantages and disadvantages. Obviously, it produces a more real picture of the fishing exploitation. However, on the other hand we might add another important source of uncertainty to the assessment model and increasing the parameterization of the model.

4. The most important effect of discard inclusion is the chance of shifts on short and medium term predictions, particularly when the management procedure becomes to focus on these aspects.

References

Allen, M., D. Kilpatrick, M. Armstrong, R. Briggs, G. Course and N. Pérez. 2002. Multistage cluster sampling design and optimal sample sizes for estimation of fish discards from commercial trawlers. Fisheries Research 55 (2002) 11-24

Anon, 2003. Report of the Working Group on the Assessment of Southern Stocks of Hake, Monk and Megrim [WGHMM]. ICES CM 2003/ACFM: 4.

Kulka, D., 1999. The integration of information collected by fishery observers into the fisheries management process: A scientific perspective. The international conference on integrated fisheries monitoring proceedings. Rome, FAO: 249-259

Lart, W. (co-ordinator). 2002. Monitoring of discarding and retention by trawl fisheries in Western Waters and the Irish Sea in relation to stock assessment and technical measures. Final Report. Contract Ref. 98/095

Lema, L., N. Pérez, R. Duarte and P. Lucio, 2002. Some sources of variation in the assessment when introducing unaccounted mortality due to discarding practices. The case of Southern Four spot megrim stock. ICES CM 2002/V:14

Pérez, N., V. Trujillo and P. Pereda. 1999. Landings and Discards of the trawl fleets of Spanish ICES Divisions VIIIc and IXa in 1997. In: On-board sampling of fish landed and discarded by commercial vessels. Final Report to the Commission of the European Communities. EC Project: 95/094

Trenkel, V., Péronnet, I., Rochet, M.-J., 2000. Estimation of fisheries discards with an example from the Celtic Sea. Working paper to the ICES Study Group on Discards and By-catch Information., 1-6.

Table I. Discard data by different areas and years.

Name	ICES Area	Years														
		87	88	89 - 92	93	94	95	96	97	98	99	00	01	02	03	04
Hake	VI-VII	D, L	D, L			D, L					D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Hake	VIIIc-IXa				D, L	D, L			D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Megrim	VI-VII	D, L	D, L			D, L					D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Megrim	VIII-IXa				D, L	D, L			D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Fourspot megrim	VI-VII	D, L	D, L			D, L					D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Fourspot megrim	VIII-IXa				D, L	D, L			D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
White anglerfish	VI-VII	D, L	D, L			D, L					D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
White anglerfish	VIII-IXa				D, L	D, L			D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Black anglerfish	VI-VII	D, L	D, L			D, L					D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
Black anglerfish	VIII-IXa				D, L	D, L			D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU	D, L, A, W, FU		D, L, A, W, FU	D, L, A, W, FU
D is discard Ratio; L is Length frequencies; A is Age length keys; W is average Weight by age; FU is sampling by Fishery Unit																